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Abstract

A MEASUREMENT OF THE OCCURRENCE OF MINIMUM DILUTION RATES FOR STACK EFFLUENTS IN THE ATMOSPHERE

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1. When the rate of release of radioactive material to the atmosphere is divided by the concentration at ground level downwind, a coefficient K is obtained which is important in assessing the consequences of an accidental release of fission products from a nuclear reactor. If its value were known it could be used to specify the siting and containment provisions necessary in order that the reactor might not be a hazard to the population. K varies widely between infinity and some minimum value depending on the wind direction, weather conditions and the time period of the release. When calculating the value of K to be used in assessing the consequences of an accident it is difficult to select numbers for the parameters in the diffusion equation, although it is usual to assume that there is an inversion during the release. The resulting values of K may be so pessimistic as to be unrealistic because the postulated diffusion conditions occur so rarely or persist for very short periods.

2. This work was undertaken to determine, from operating experience in an area surrounding a stack, the lowest values of K as well as their frequency and duration. The tracer used was ^{41}Ar, produced during passage of cooling air through the NRX and NRU reactors and discharged through a single stack at the Chalk River Nuclear Laboratories. These Laboratories lie by the Ottawa River on terrain which is typical of that surrounding many inland power-reactor sites. The results of these studies should therefore be applicable to other locations.

3. Four sampling stations were established along a line parallel to the river valley and also to the direction of the prevailing winds. Three were located in one direction at 1.5, 4.8 and 9.6 km respectively from the stack and the fourth at 1 km in the diametrically opposite direction. The results could therefore be used to determine the effect of distance on the values of K and also on the probability of their occurrence.

4. In the first half of 1963 the lowest values of K recorded at each of the four sampling points were not significantly different from one another (average about 4×10^4 m^3/s). The effect of distance from the point of release was, however, to reduce markedly the probability of occurrence of such low values. Thus for values of K in the range 3 to 10×10^4 m^3/s, the percentage incidence decreased from about 2% at the nearest to about 0.01% at the furthest location.

5. The results so far obtained have been used in Canada to assess the containment provisions necessary for the Nuclear Power Demonstration reactor at Rolphton, Ontario and the experimental reactor, WR-1, to be built at Whiteshell, Manitoba.